3 Paving Equipment

Distributors

Pavers

Widening Machines

Rollers

Two-Axle Tandem Roller
Three-Wheel Roller
Pneumatic-Tired Roller
Vibratory Roller
Trench Roller

Material Transfer Vehicles

Haul Trucks

Hand Tools

CHAPTER THREE:
PAVING EQUIPMENT

Before paving operations may be started, all of the paving equipment is required to be checked for conformance with the Specifications and the Contractor's Quality Control Plan. If the equipment functions properly, the chances of a successful paving operation are greatly increased.

The major pieces of paving equipment on a HMA contract are distributors, pavers, material transfer devices, widening machines, rollers, and hauling units (trucks). Each piece of equipment is required to be checked prior to beginning the paving operation to ensure that the equipment is in good working order and in compliance with specific requirements.

DISTRIBUTORS

A distributor is used to apply liquid asphalt material such as prime and tack coats to surfaces to be paved. The distributor consists of an insulated tank mounted on a truck or trailer. A power-driven pump forces the asphalt through a system of spray bars and nozzles onto the construction surface. A burner, usually oil-fired with flues within the tank, is used to heat the asphalt to the proper application temperature. The major units for a typical distributor are indicated in Figure 3-1.

The distributor is required to:

1) Maintain the liquid asphalt at a uniform temperature

2) Apply material at a uniform rate

3) Apply material at variable widths

The distributor is required to be equipped with:

1) A tachometer (Bitumeter) to measure the speed during applications

2) Pressure gauges

3) Accurate volume measuring gauges or a calibrated tank

4) A thermometer for measuring temperatures

5) A power unit for the pump

6) Full circulating spray bars to prevent material cooling in the spray bars. The spray bars are required to be adjustable both laterally and vertically.

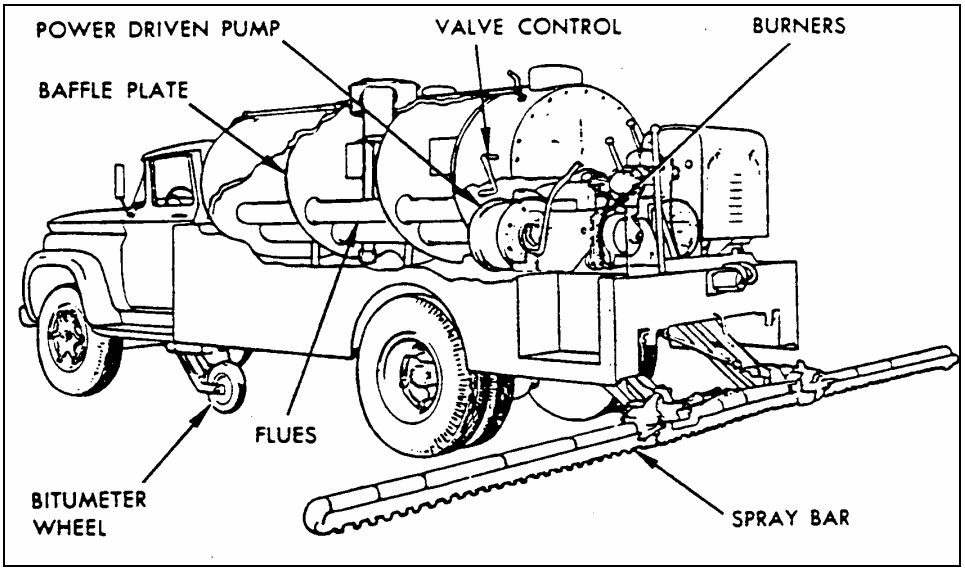

Figure 3-1. Distributor

PAVERS

Most HMA mixtures are placed by a paver (Figure 3-2) or finishing machine. The HMA paver spreads the mixture in either a uniform layer of a desired thickness or a variable layer to a desired elevation and cross section. Upon placement, the HMA is ready for compaction.

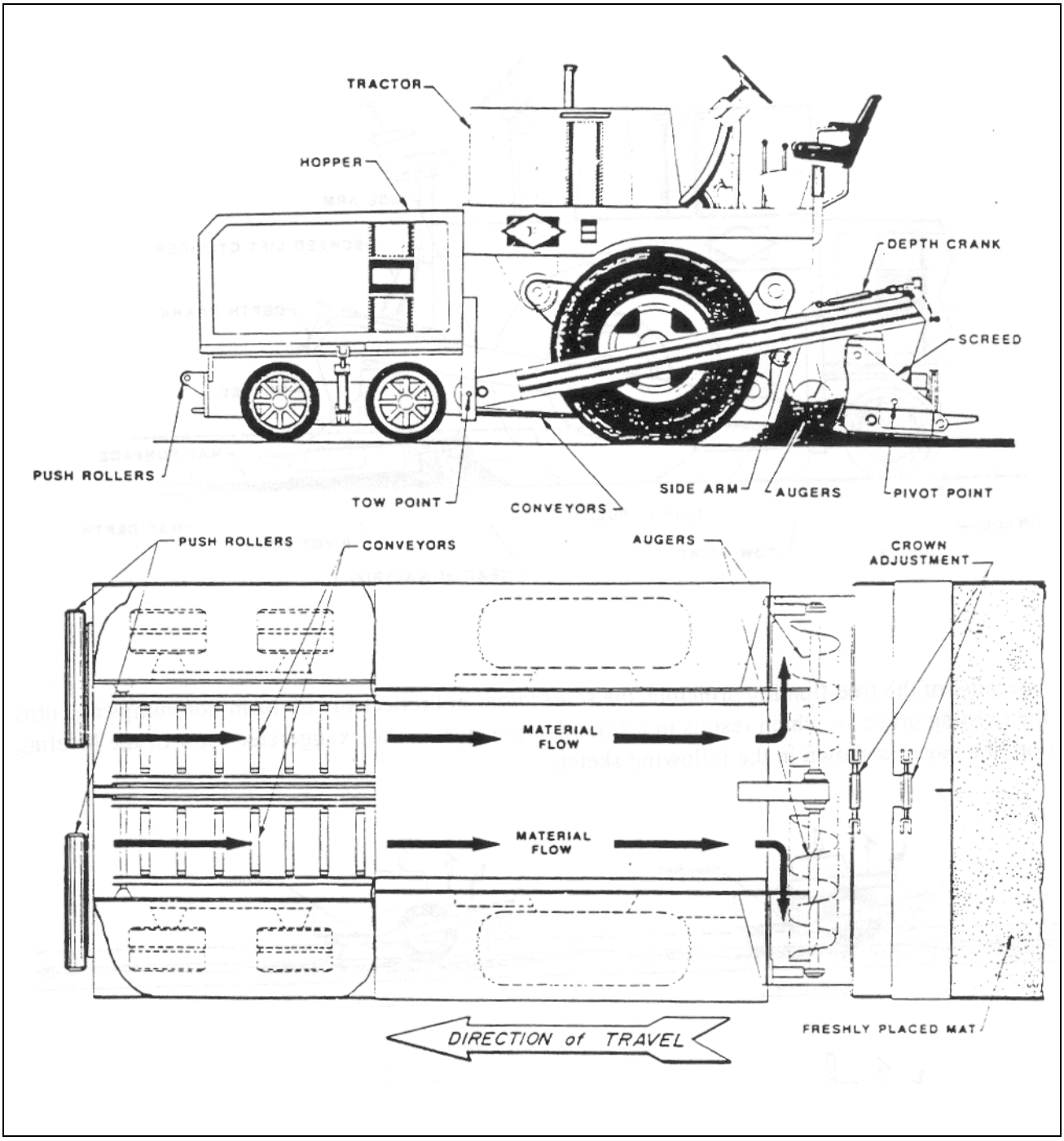

Figure 3-2. HMA Paver

The paver consists essentially of a tractor and a screed. The tractor receives, conveys, and augers the mixture to the screed and propels the screed forward. The tractor may be mounted on either rubber tires or crawlers. In addition to the engine, the tractor unit has a hopper for receiving mix from the haul trucks, conveyors to move the mix through the flow control gates to the augers, flow gates to regulate the flow of mixture to maintain uniform auger speed, and augers to evenly spread the mix in front of the screed. Rollers are mounted on the front of the tractor to push the haul trucks during the dumping process. The rollers turn freely so the trucks have little effect on paver operation. The screed conducts the actual placing of HMA to the desired width and thickness or elevation as indicated in Figure 3-3. The screed is towed by the tractor and is free to float up or down until the bottom of the screed is parallel with the grade over which the screed is traveling.

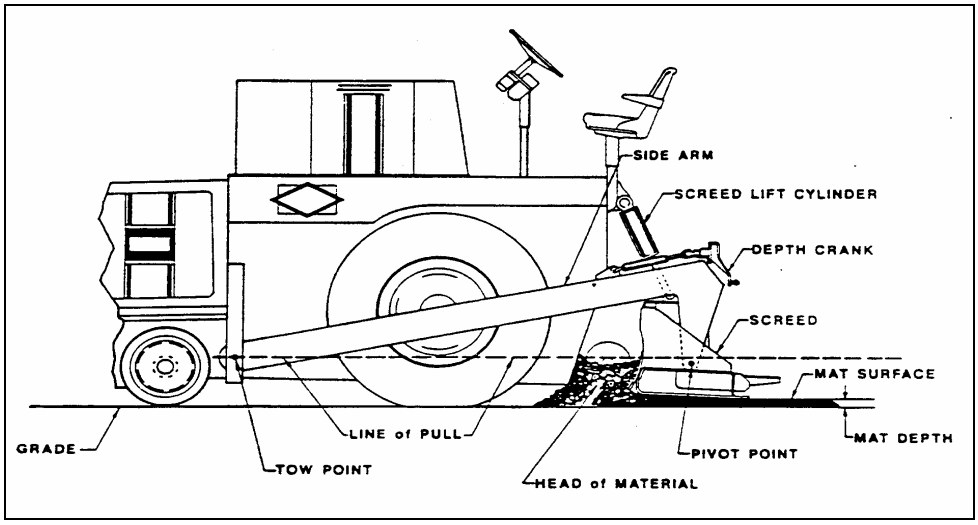

Figure 3-3. Paver Components

Because of the free-floating principle, the screed does not reflect any of the minor bumps and dips in the existing grade which results in a smoother pavement. An exaggerated view of the leveling action of a paver is indicated in Figure 3-4.

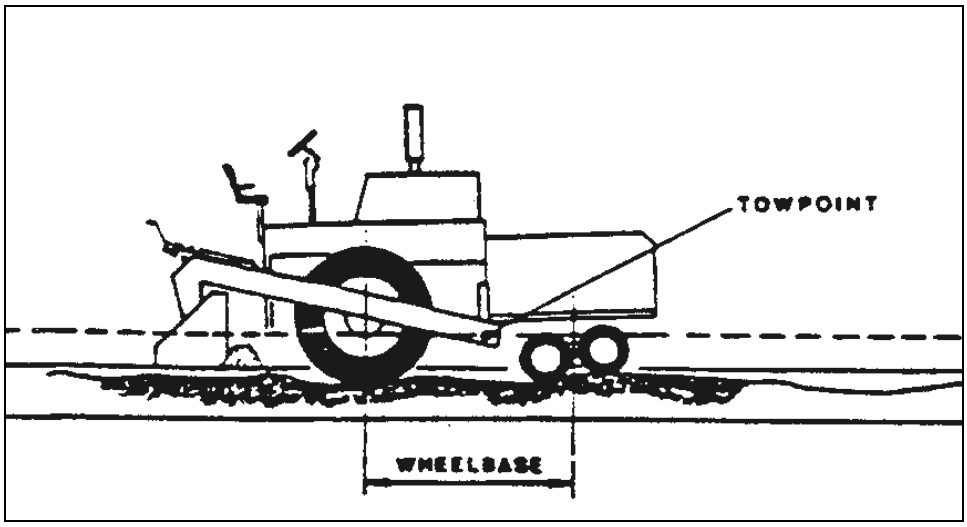

Figure 3-4. Free-Floating Screed

The relationship between the vertical movement of the screed tow point and the elevation of the screed is illustrated in Figure 3-5. There is an 8 to 1 ratio between the tow point and the elevation; therefore, a 1 in. vertical movement of the tow point results in only a 1/8 in. vertical corrective movement of the screed. Before the 1/8 in. movement is made, the paver moves five times the length of the screed side arm. This relationship is the key to the paver's ability to lay smooth pavements.

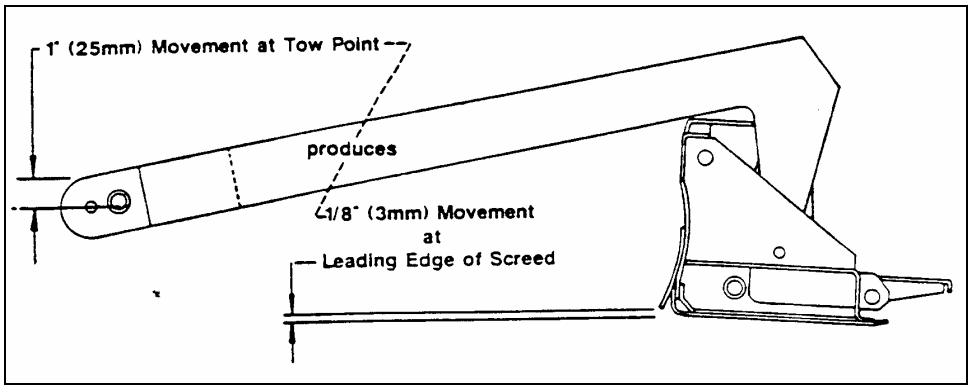

Figure 3-5. Screed Tow Point and Elevation

Section **409** requires that a paver (Figure 3-6):

1) Be a self-contained power propelled unit

2) Be equipped with an activated (vibratory) screed or strike-off assembly capable of being heated for the full length, including extensions

3) Be capable of spreading and finishing mix in lane widths indicated on the typical sections for the contract

4) Be equipped with automatic grade and slope controls if the width of the roadway or shoulder to be paved is 8 ft or wider. The operator's control panel is required to have gauges that indicate compliance with the established grade and slope.

5) Have a grade leveler (commonly called a ski or mat reference) for attachment to the paver to activate the automatic grade control

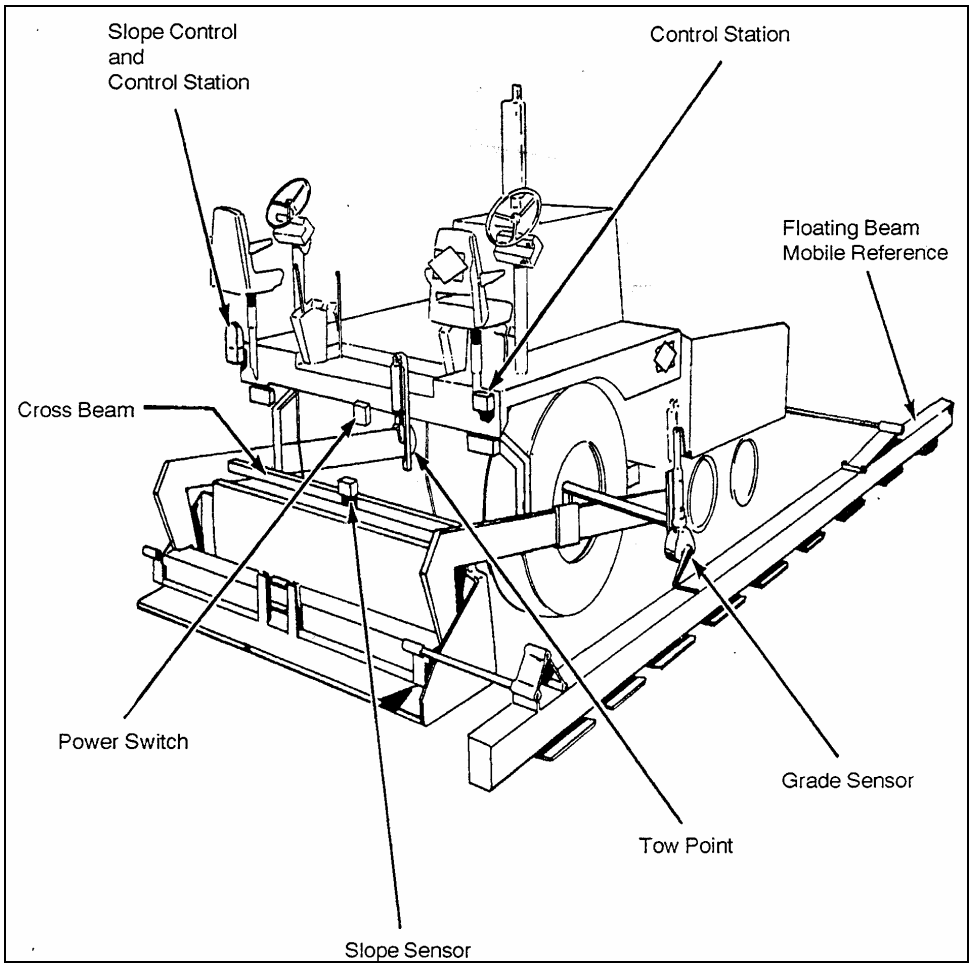

Figure 3-6. Paver Screed Controls

The automatic screed controls may be set for manual, semiautomatic, or automatic operation on most pavers. Automatic screed controls typically have the following main components:

1) Grade sensor

2) Slope sensor

3) Control station

4) Slope control

5) Motors and hydraulic cylinders to change the screed tilt

The grade sensor rides on a stringline, a ski, or a joint matcher to detect changes in elevation and transmit the information electronically to the controls. The electronic controls may be checked by varying the position of the grade sensor and observing if the screed controls react to make the correct adjustment. When the ski is used, the grade sensor is required to always ride on the center of the ski so that all elevation changes are averaged.

Use of the automatic controls further enhances the paver's capability to produce a smooth pavement surface regardless of irregularities in the surface being paved. Crown or superelevation slope is controlled by the slope sensor or pendulum set for the desired slope. Once the screed is set for the desired mat thickness and slope, the automatic controls activate the motors or cylinders to change the screed tilt to automatically compensate for road surface irregularities. Automatic slope and grade controls are required to be used as outlined in the Quality Control Plan (QCP).

WIDENING MACHINES

Widening machines (Figure 3-7) are used when the width to be laid is too narrow or inaccessible for the regular paver. The inside 4 ft wide shoulder of a dual-lane highway is one example of when HMA may be placed separately using a widening machine.

Widening machines are required to be self-propelled and capable of placing material at variable widths. Vibrating or heated screeds and automatic grade and slope controls are not required for these machines; however, automatic grade controls for matching joints are available on some models. Self-propelled wideners are usually used for widths up to 4 ft, and wideners mounted on motor-graders are used for widths between 4 ft and 8 ft. The use of widening pavers is not allowed on widths of 8 ft or more.

Figure 3-7. Widening Machine

ROLLERS

Five types of rollers are used for compacting HMA: two-axle tandem, three-wheeled, pneumatic tire, vibratory, and trench. All of the rollers have steel wheels, except for the pneumatic-tire roller which has rubber wheels.

All rollers are required to have proper sprinkling systems to wet the drums or tires to prevent the mix from sticking. Scrapers are usually required on steel-wheel rollers. Rollers are required to be equipped with drip pans to prevent oil, grease, or fuel from dropping onto the roadway. Any petroleum product damages HMA pavement. Clutches are required to function smoothly. A roller that jerks when starting, stopping, or reversing causes a rough surface.

QC/QA mixtures in accordance with Section **401** are compacted with rollers designated in the Contractor's Quality Control Plan. HMA mixtures are required to be compacted by the rollers designated in Section **409.03(d)**, and SMA mixtures are compacted with rollers in accordance with Sections **409.03(d)1**, **409.03(d)2**,and **409.03(d)6**.

TWO-AXLE TANDEM ROLLER

A two-axle tandem steel-wheel roller (Figure 3-8) is required by Section **409.03(d)1** to weigh at least 10 tons.

Figure 3-8. Two-Axle Tandem Roller

THREE-WHEEL ROLLER

The three-wheel roller (Figure 3-9) is required by Section **409.03(d)2** to have a compression or drive rolls that produce a bearing of at least 300 pounds per linear inch of roll width. This bearing weight is computed by dividing the weight of the drive axle by the combined width of the two rolls. A tandem roller, which has a drive wheel bearing of no less than 300 pounds per linear inch may be used in lieu of the three-wheel roller.

Figure 3-9. Three-Wheel Roller

PNEUMATIC-TIRED ROLLER

A pneumatic-tired roller (Figure 3-10) is required by Section **409.03(d)3** to:

1) Be self propelled

2) Have a minimum width of 5 ft 6 in.

3) Be equipped with wide-tread compaction tires, with a minimum size of 7:50 by 15

4) Be capable of exerting a uniform, average contact pressure from 50 to 90 pounds per square inch over the surface by adjusting ballast and tire pressure

5) Have wheels on at least one axle that are fully oscillating vertically and so mounted so as to prevent scuffing of the surface during rolling or turning

Figure 3-10. Pneumatic-Tire Roller

The tires on a pneumatic-tired roller are typically arranged so the gaps between the tires on one axle are covered by the tires of the other as shown in Figure 3-11.

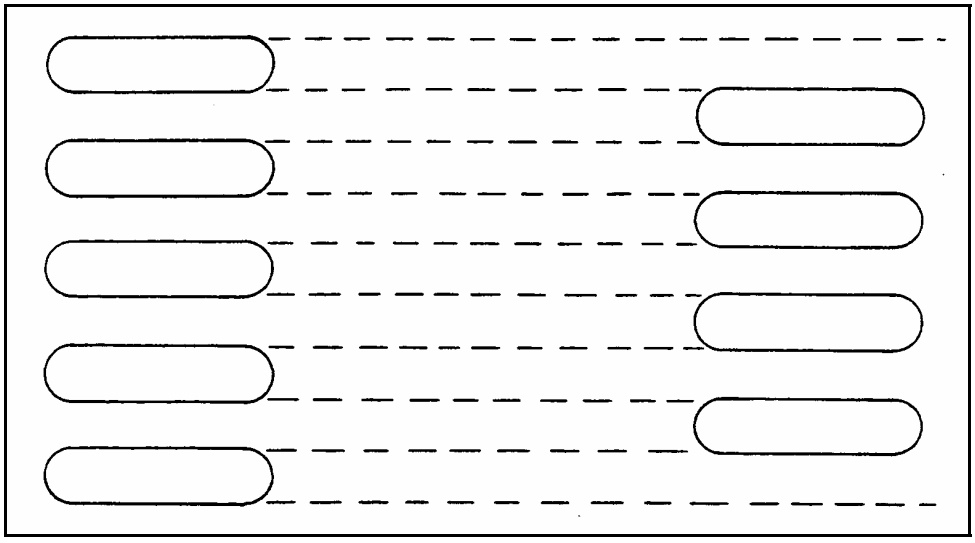

Figure 3-11. Pneumatic-Tired Roller Tires

The Contractor is required to furnish charts and tabulations indicating the contact areas and pressures for the full range of tire inflation pressures and for the full range of tire loadings for each type and size of pneumatic-tired roller to be used.

VIBRATORY ROLLER

A vibratory roller (Figure 3-12) is a steel-wheeled roller that has the capability of oscillating one or both of the steel rollers.

Figure 3-12. Vibratory Roller

Only vibratory rollers specifically designed for the compaction of HMA may be used. Vibratory rollers are required by Section **401.09(d)5** to be equipped with a variable amplitude system, a speed control device, and have a minimum vibration frequency of 2000 vibrations per minute. A reed tachometer is required to be provided by the Contractor for use in verifying the operation frequency.

TRENCH ROLLER

When the width of a trench is too narrow to accommodate a standard roller, a trench roller (Figure 3-13) is used for compaction. The trench roller is required by Section **401.09(d)5** to be of sufficient weight to exert a pressure of 300 pounds per linear inch of width for the compression wheel. The compression wheel may be either hollow or solid. Weight is added to hollow wheels by filling the wheel with water ballast. Counter-weights are used for rollers with solid wheels.

To provide uniform compaction for the entire width of the compression wheel, the face of the wheel is required to be parallel to the surface being compacted. Trench rollers use a vertical adjustment on the wheel not in the trench to tilt the machine to accomplish this uniform compaction.

Figure 3-13. Trench Roller

MATERIAL TRANSFER VEHICLES

Material Transfer Vehicles (Figure 3-14) or Shuttle Buggies are used to transfer mix from the haul trucks to the paver. The use of a Material Transfer Vehicle may greatly reduce the chances of segregation in the mixture and ad in maintaining a uniform paver speed.

Figure 3-14. Material Transfer Vehicle

HAUL TRUCKS

Haul trucks (Figure 3-15) used to transport the HMA to the paver are required to be continuously monitored. Some checks the HMA Technician makes include:

1) Watch for truck beds that are leaking mix because the gates are not tight

2) Watch for foreign material in the mix which would indicate that the beds were not clean when loaded

3) Be sure the trucks are equipped with tarps and that the tarps are in place when needed to keep the material from cooling or becoming contaminated on route to the paver

4) Make sure the tarps overlap the bed of the trucks enough to prevent rain and foreign material from getting into the mix

5) Have the tarps rolled back to inspect the appearance of the mix before allowing the load to be dumped

6) Watch for evidence of the excess use of anti-adhesive agent

7) Check each truck for an easy to read identification number

8) Make sure there are no hydraulic or fuel leaks

Figure 3-15. Haul Truck

HAND TOOLS

Normal hand tools used in the paving operation include shovels, lutes, and ten-foot straightedges.